Jr. of Industrial Pollution Control 33(S3)(2017) pp 1419-1421
www.icontrolpollution.com
Review Article

COMPARATIVE STUDY OF FLAT SLAB UNDER SEISMIC LOAD ACCORDING TO INDIAN STANDARD AND UNIVERSAL BUILDING CODE

SHREYA NAIK[1*] AND VASUGI V[2]

[1]M.Tech Structural Engineering, SMBS, VIT University - Chennai Campus, Chennai

[2]Associate Professor, SMBS, VIT University - Chennai Campus, Chennai

(Received 17 June, 2017; accepted 24 November, 2017)

Key words: Flat slab with drop, Response spectrum analysis, Maximum story displacement

ABSTRACT

In today's world of modern construction tall structures are taking place to overcome land problem. The use of flat slab is becoming very popular because it increases the construction speed, reduces dead weight. But it has poor performance under lateral load, due to thesis reason flat slab are generally avoided in India for high seismic zone. To improve the performance of structure and to make flat slab stiffer, drops are provided under flat slab. This study is to check performance of flat slab under seismic load situated in high seismic zone according to guideline of IS-1893(part 1):2002 and UBC-97. The results of maximum story displacement are compared for both codes.

INTRODUCTION

In this modern era of infrastructure development the main issue is the shortage of land. To overcome this problem the tall building construction has been taking place very quickly. To make the construction quick and economical some elements are modified and flat slab is introduced in construction. It makes the beam invisible, reduces dead load and increases floor area. Its main advantages that it provides more head room so for the same building number of floors increases. Due to absence of shear walls and deep beams this system is more flexible to lateral loads. Because of this type of behavior flat slab are mostly avoided by people to use in high seismic zones. The present work is to examine the behavior of flat slab with drop for seismic loads in high seismic zone using Indian Standards and to compare it with standards of universal building code.

LITERATURE REVIEW

Farhy, *et al.*, 1993 check the lateral load effect for RC flat slab and column sub assemblages and get failure shape. (Quian, *et al.*, 2013) did the retrofitting and strengthening of flat slab using CFRP laminates. (Micallef, *et al.*, 2014) check the punching shear failure because of impact loading on RC flat slab. Increasing in stiffness rather than enhancement of material property is more dominant. (Soni and Raval, 2014) examine the behavior of flat slab with drop when subjected to different types of loading. (Askar, 2015) used prestressed bolts for retrofitting of flat slab failed in punching shear.

(Chan, 1987) did Response Spectrum Analysis to study offshore platforms. (Asthana, *et al.*, 1989) performed random vibration analysis with the use of response spectrum analysis method to study behavior of flexible base building. In this method spectral approach is used to fine mode shapes and natural frequencies. (Chandak, 2012; Coelho, *et al.*, 2004; Sable, *et al.*, 2012) used response spectrum analysis to check the behavior of reinforced concrete structure. Design spectrum of Indian code, UBC code and Euro code 8 is compared. Results said that base shear from the Indian code is higher.

***Corresponding authors email: ssnaik1994@gmail.com**

MODELING

Two models of flat slab with drop structures are prepared and analyzed in ETABS 15.0.0 software. Total height of building is 31 m. first model is prepared according to IS-1893 (part 1):2002. According to IS code thickness of flat slab shall be generally considered based on span to depth ration. Minimum thickness should be at least 125 mm. second model is prepared for UBC 97 (Fig. 1 and 2).

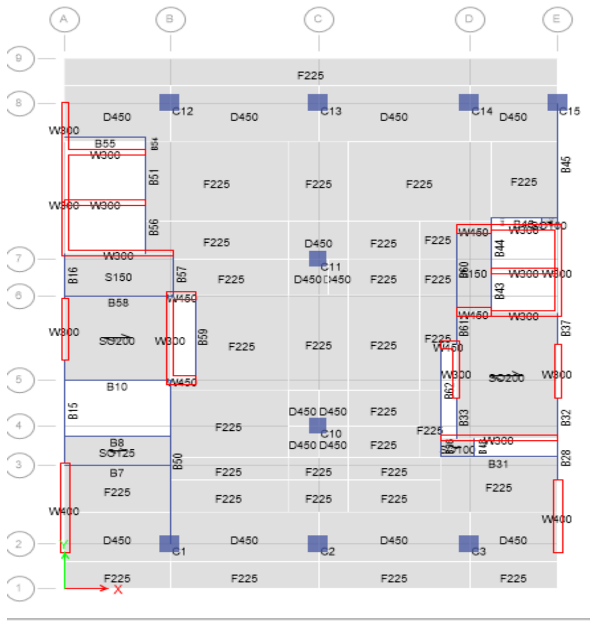

Fig. 1 Plan of flat slab with drop model.

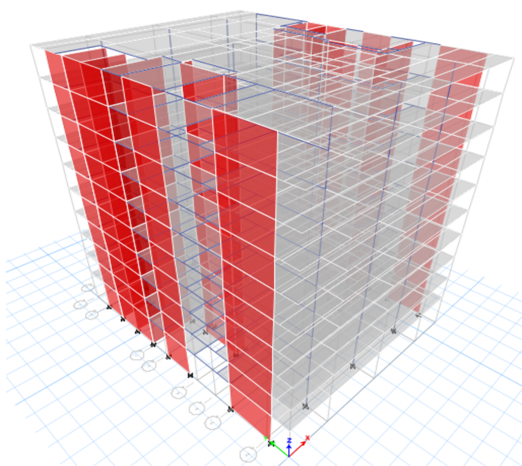

Fig. 2 Elevation of model.

EARTHQUAKE LOAD DATA

As the height increases, the structure gets more flexible to lateral loads. If the height of the structure is not enough for wind load effect than the major lateral load effect takes place due to earthquake load. So it becomes necessary to analyze the structure for seismic force in high seismic zone and to provide an alternative of conventional slab system.

Response Spectrum Analysis: For the response spectrum analysis first the response spectrum function is defined using both the code. For defining model case, Ritz vector is defined because it gives better participation factor. Initially scale factor is taken as 1 for both models. After analyzing the model base reaction is checked because it should be 80% of the response spectrum base reaction. For that the scale factor is being modified as per given formula Tables 1 and 2.

For IS Code: Scale factor=

$$0.8 \times \frac{I \times 9}{2 \times R} \times \frac{static\ base\ shar}{response\ spectrum\ base\ shear}$$

For UBC code: Scale factor=

$$9.81 \times \frac{static\ base\ shar}{response\ spectrum\ base\ shear}$$

Table 1. Seismic load input

Earthquake load property	IS-1893 (part 1):2002	UBC 97
Importance factor I	1.5	1.5
Response reduction factor R	4	3.5
Type of soil	Medium soil (Type II)	SD
Seismic zone	V	4
Seismic zone factor Z	0.36	0.40

Table 2. Structural property of model

No. of story	G+8
Beam size	300 × 800 mm
Column size	900 × 900 mm
Bottom story height	4 m
Story height	3 m
Thickness of flat slab	225 mm
Thickness of drop	450 mm

RESULT AND DISCUSSION

Performance of both models is been analyzed and behavior is observed for maximum story displacement in both X and Y direction for load case EQXP and EQYP. Analysis says that flat slab with drop system reduces the effect of lateral loads on high rise building. It also reduces the construction time.

In the (Fig. 3-6) shows that the displacment according to UBC 97 code is high compare to IS-1893 (part 1):2002. The main reason for that is, the seismic zone factor value is more in UBC code than Indian code. The consideration of risk accesment factor from the past earthquake is taken accuratly. From this analysis it can be said that in the indian standard

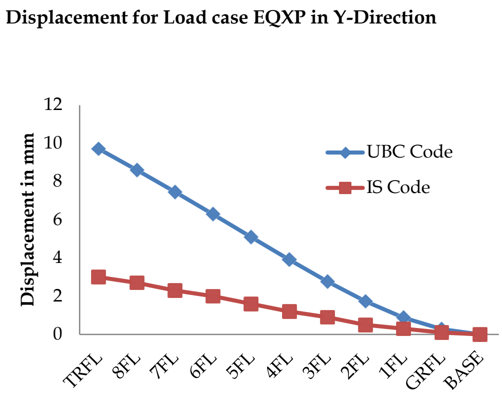

Fig. 3 Displacement in X-direction.

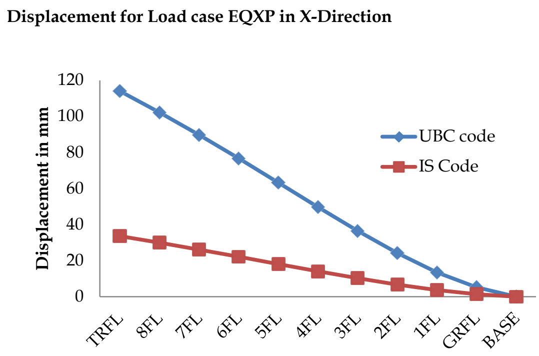

Fig. 4 Displacement in Y-direction

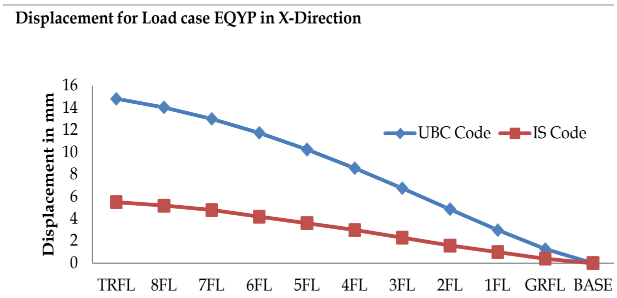

Fig. 5 Displacement in X-direction.

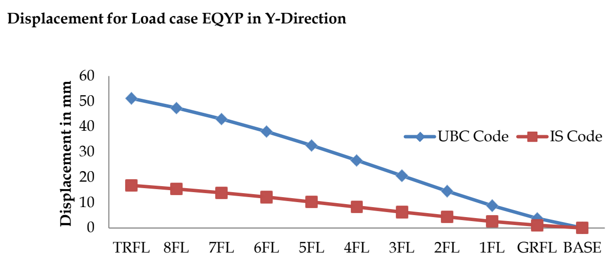

Fig. 6 Displacement in Y-direction.

code, the effect of the seismic load is underestimated compare to UBC code. From the past dissaster occurred due to eathquake, Maximum Considered Earthquake should be taken properly (Fig 3-6).

CONCLUSION

Two models of flat slab with drop in high seismic zone are analyszed according to the standared of UBC 97 and IS-1893 (part 1):2002 using Response Spectrum Analysis Method. Analysis concluded that it is better to use flat slab with hdrop system in high rise buildings because it reduces the maximum story displacent and also increase story height and deceases construction time. IS code gives lesser value of displacment cmapre to UBC code. In UBC code the seismic risk characteristics by maximum Considered Earthquake in the Zone where the steucture is taken high as 0.40, where in the IS code it is taken as 0.36 which is less than UBC code. From this study, it can be said the the disaster from the paster earthquake is not considred properly in indian standared code.

REFERENCES

Askar, H.S. (2015). Usage of prestressed vertical bolts for retrofitting flat slab damaged due to punching shear. Alexandria Engineering Journal.

Chandak, N.R. (2012). Response spectrum analysis of reinforced concrete building. Journal of the institution of Engineers. 93(2) : 121-128.

Coelho, E., Paulo, C., Giorgios, A., Raul, Z., Fabio, T. and Pinto A.V. (2004). Assessment of the seismic behaviour of RC flat slab building structures. 13th world conference on earthquake engineering vancouver, b.c. Canada. 1-6. paper no. 2630.

Sable, K.S., Ghodechor, V.A. and Kandekar, S.B. (2012). Comparative study of seismic behavior of multistory flat slab and conventional reinforced concrete framed structures. International Journal of Computer Technology and; Electronics Engineering. 2.

Soni, R.P. and Raval, D.H. (2014). Parametric study of flat slab with various loading types and panel aspect ratio. International Journal of Engineering Development and Research. 2 : 2321-9939.